Date: 1 September 1999

MEMORANDUM

SUBJECT: OCCUPATIONAL AND RESIDENTIAL EXPOSURE ASSESSMENT AND RECOMMENDATIONS FOR THE REREGISTRATION ELIGIBILITY DECISION DOCUMENT FOR ETHYL PARATHION (Revised, Phase 4)

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Please find attached the occupational and residential exposure assessment for Ethyl Parathion that has been revised to reflect comments received on the preliminary risk assessment. This chapter uses a streamlined format.

DP Barcode: 240988

Pesticide Chemical Codes: 057501

EPA Reg Nos: 4787-16-67760; 4787-17; 4787-91

EPA MRID No.: N/A

PHED: Yes, Version 1.1

Ethyl Parathion

This occupational exposure and risk assessment for ethyl parathion reflects the incorporation of comments received during the public comment phase and the results from a re-evaluation of the non-dietary toxicological endpoint. This document uses an abbreviated format.

I. Hazard Identification

Table 1 summarizes the critical toxicological information from *Ethyl Parathion: Re-evaluation of Dietary and Non-dietary Endpoint Selection, Report of the Hazard Identification Assessment Review Committee, August 20, 1999.* Potential for long-term exposures were not identified by HED. Ethyl parathion is classified as a Group C (possible human) carcinogen. Based on the active ingredient, the acute oral and dermal toxicity are category I, acute inhalation toxicity is category II, primary eye and skin irritation data requirements were waived (based on acute oral toxicity). Ethyl parathion is not a dermal sensitizer.

Table 1. Ethyl parathion hazard endpoints and uncertainty factors.

Route / Duration	NOAEL (mg/kg/day)	Endpoint	Study	Uncertainty Factors	Comments
Short-term / Dermal	0.01	Plasma ChE Inhibition	6-month Oral Study in Dogs (MRID 41836601)	Interspecies: 10x Intraspecies: 10x FQPA: None Target MOE is 100.	Plasma cholinesterase inhibition seen in male and female dogs after 1 week of dosing at 0.8 mg/kg bw/day. Standard value of 100 percent dermal absorption used.
Short-term / Inhalation	0.01	Plasma ChE Inhibition	6-month Oral Study in Dogs (MRID 41836601)	Interspecies: 10x Intraspecies: 10x FQPA: None Target MOE is 100.	No inhalation study available. Exposure is converted to an oral equivalent dose, combined with the dermal dose, and compared to the oral endpoint.
Intermediate-term / Dermal	0.002	Plasma and RBC ChE Inhibition	6-month Oral Study in Dogs (MRID 41836601)	Intraspecies: 10x Intraspecies: 10x FQPA: None Target MOE is 100.	Plasma and red blood cell cholinesterase inhibition in both male and female dogs at week 6 at 0.008 (0.01) mg/kg bw/day. Standard value of 100 percent dermal absorption used.
Intermediate-term / Inhalation	0.002	Plasma and RBC ChE Inhibition	6-month Oral Study in Dogs (MRID 41836601)	Interspecies: 10x Intraspecies: 10x FQPA: None Target MOE is 100.	No inhalation study available. Exposure is converted to an oral equivalent dose, combined with the dermal dose, and compared to the oral endpoint.

II. Exposure Characterization

Ethyl parathion is an restricted use pesticide formulated solely as an emulsifiable concentrate (81 and 44 percent active ingredient). The registrants entered into an agreement with EPA (57 FR 65061, December 13, 1991) to limit the use of ethyl parathion to nine crops (alfalfa, barley, canola, corn, cotton, soybeans, sorghum, sunflower, and wheat). The agreement also increased the handling restrictions to help prevent mixer/loader and applicator exposure. Occupational mixer/loaders must use closed mixing systems. The liquid ethyl parathion must be removed from its original shipping container and transferred to the mixing tank using hoses equipped with a dry-couple shut-off device that will minimize drips to not more than 2 ml per disconnect. An observer must be present during all mixing/loading activities in order to assist in the event of an accident.

The only application method permitted is by aircraft (by certified commercial applicators) and human flaggers are strictly prohibited. The pilot may not apply ethyl parathion if they have earlier in the day performed any mixing/loading activities. Currently there are approximately 2600 aerial pesticide applicator companies in the United States. Each company typically employs 1 to 2 pilots.

No reentry is allow under any circumstances for the first 4 hours following the end of the application. Current labels state the restricted-entry period is 3 days (6 days for corn). Entry into the entry-restricted areas during this time is limited to workers scouting and irrigating the crop.

All workers entering a treated area under restricted reentry must wear PPE consisting of coveralls over long-sleeved shirts and long pants, chemical resistant boots and chemical resistant gloves. A crop that has been treated with parathion must be harvested by mechanical means only. Ethyl parathion is also formulated with methyl parathion (as a 6 lb ethyl parathion / 3 lb methyl parathion per gallon formulation).

Routes of potential occupational exposure are dermal and inhalation. Occupational exposure durations are short- (1 to 7 days) and intermediate-term (1 week to several months). HED has not identified the potential for occupational chronic exposures.

There are no labeled residential uses. However, HED believes that residential exposures may result from spray drift from the aerial application of ethyl parathion to agricultural fields adjacent to residential areas. HED did not quantitatively assess the exposures and risk to individuals who live adjacent to farm fields and that could potentially be exposed to ethyl parathion from spray drift. Methods to assess these risks are currently being developed by the Agency, and these assessments will be conducted in the future when these methods are available. However, based on the current information, HED remains concerned about the potential risks from this source.

III. Occupational Exposure and Risk Assessment

Application Rates: The registrant, Cheminova, is supporting the following crop-specific application rates for ethyl parathion (Table 2).

Table 2. Ethyl parathion crop-specific application rates.

Crop	Application Rate (lb ai / acre)
Alfalfa, Canola	0.5
Barley, Corn, Soybeans, Wheat	0.75
Cotton, Sorghum, Sunflower	1

As part of the Reregistration process, the crop-specific application rates on all labels should be amended to correspond to the above rates.

- *Submitted Studies:* HED is not aware of any additional studies relating to occupational exposure assessments submitted by the registrant since the ethyl parathion consent agreement in 1991.

- *Handler Exposure Scenarios:* HED has identified three major exposure scenarios for the occupational handler: (1) mixing / loading liquids for aerial application; (2) applying sprays with fixed-wing aircraft; and (3) applying sprays with helicopter. Human flaggers are prohibited for this chemical. Occupational handler short-term and intermediate-term dermal and inhalation exposures (developed using PHED Version 1.1 surrogate data) are presented in Table 5. Table 6 presents occupational handler short- and intermediate-term risks from ethyl parathion at baseline. Table 7 presents occupational handler short- and intermediate-term risks from ethyl parathion with maximum PPE and Table 8 presents occupational handler short- and intermediate-term risks from ethyl parathion with engineering controls. The formulae that were used in the exposure / risk calculations are documented in the table footnotes and the assumptions that were used are noted in Table 9.

- *Helicopter Application of Sprays:* Data from PHED for helicopter application of sprays are based on a very limited number of replicates. Instead of assessing this exposure scenario using inadequate data, data from PHED for fixed-wing application of sprays were used in accordance with HED Science Advisory Council for Exposure Policy Number 5 (May 7, 1998).

- *Handler Exposure Scenario Results:* Results for the occupational handler scenarios are presented in Tables 5 through 8 and are summarized below in Table 3.

Table 3. Range of short- and intermediate-term total MOEs for each ethyl parathion exposure scenario.

Exposure Scenario	Restrictions / Risk Mitigation	Range of Total MOEs	
		Short-Term	Intermediate-term
Mixing/loading liquids for aerial applications	Baseline Clothing	0.00069 – 0.0014	0.00014 – 0.00028
Mixing/loading liquids for aerial applications	Maximum PPE	0.12 – 0.23	0.023 – 0.047
Mixing/loading liquids for aerial applications	Engineering Controls	0.23 – 0.46	0.046 – 0.092
Applying sprays with fixed wing aircraft		0.39 – 0.79	0.079 – 0.16
Applying sprays with helicopter		See fixed-wing aircraft data	See fixed-wing aircraft data

- *Postapplication Exposure Scenarios:* One scenario has been selected to assess to represent postapplication exposures to agricultural workers. This scenario, scouting in cotton, was selected to represent reasonable activities that would occur in the nine crops on ethyl parathion labels. The transfer coefficient (TC) for scouting in early season cotton is estimated to be 1,000 cm^2/hr and to be 4,000 cm^2/hr for late season cotton. These transfer coefficients would also represent scouting activities in the other crops (HED Scientific Advisory Council for Exposure Policy Number 3; May 7, 1998). It is assumed that 20 percent of ethyl parathion is available as dislodgeable residues and that it dissipates at a rate of 10 percent per day. The dissipation rate used approximates reports in the open literature that ethyl parathion is degraded within weeks (Hazardous Substances Data Bank Retrieval, 1998). Further, Cheminova, in its response to the preliminary risk assessment, used a foliar half-life of 2.9 days as an input to its environmental fate model. This half-life also approximates a dissipation rate of 10 percent per day.

  Because there are cases of early entry (scouting, irrigating) into restricted-entry areas wearing PPE, an additional analysis was conducted. Assuming the addition of PPE would result in a 90 percent protection factor, transfer coefficients were adjusted to 10 percent of the standard values used above. The analysis was then conducted using transfer coefficients of 100 cm^2/hr for low crops and 400 cm^2/hr for high crops.

- *Postapplication Exposure Scenario Results:* Table 4 provides results (i.e., day after treatment where MOE is greater than 100) for an occupational surrogate Restricted-Entry Interval (REI) calculation for scouting using standard values (1 hour in treated area, TC = 1000 cm^2/hr; intermediate-term NOAEL = 0.002 mg/kg/day). All of the calculated values are significantly longer than the label REIs of 3 days.

Table 4. Calculated Restricted-Entry Interval (REI) for each crop.

Crop	Application Rate	REIs (Day when MOE is greater than 100)			
		TC = 4000	TC = 1000	TC = 400	TC = 100
Alfalfa, Canola	0.5 lb ai / acre	77	64	55	42
Barley, Corn, Soybeans, Wheat	0.75 lb ai / acre	81	68	59	46
Cotton, Sorghum, Sunflower	1.0 lb ai / acre	84	70	62	49

Formulae: Dose (mg/kg/day) = DFR (ug per cm^2) x Transfer coefficient (cm^2 per /hr) x Conversion factor (1mg per 1,000ug) x Dermal absorption x Hours worked per day x 1 / Body weight (kg)

DFR (ug/cm^2) = Application rate (lbs per acre) x (1- daily dissipation rate)^postapplication day ((1-D)^t) x Conversion factor (ug per cm^2/lb ai per acre) x fraction of ai retained on foliage (unitless)

MOE = NOAEL (mg/kg/day) / Dose (mg/kg/day)

Table 4 also provides results (i.e., day after treatment where MOE is greater than 100) for an occupational surrogate Restricted-Entry Interval (REI) calculation for scouting using PPE adjusted values (1 hour in treated area, TC = 100 cm^2/hr; Intermediate-term NOAEL = 0.002 mg/kg/day). Again all of the calculated values are significantly longer than the label REIs of 3 days.

As a simple check on these standard values, a study submitted in 1987 that was used to set the re-entry intervals was re-examined (MRID 401399-03 Ethyl Parathion: Proposal for Reentry Interval for Cotton). This study reports a dislodgeable foliar residue value for the combined parathion and paraoxon residues at or below 0.06 µg per cm^2 at 72 hours (3 days) post treatment. Using this value and the current intermediate dermal endpoint, the calculated MOEs are 2 for scouting early season cotton (TC = 1000) and 1 for late season cotton (TC = 4000) assuming that the scout (without PPE) spends 1 hour per day in the treated area. Assuming that the scout wears PPE which reduces the transfer coefficients by 90 percent (TC = 100 and 400 respectively), the calculated MOEs are 23 for scouting early season cotton and 6 for late season cotton.

IV. Residential Exposure Assessment

- *Residential Handler Exposure:* There are no residential uses of ethyl parathion.

- *Residential Postapplication Exposure:* All labels include language concerning the maintenance of a buffer zone of 100 feet from buildings, public roads, or bodies of water to minimize the exposure via spray drift to bystanders. However, without actual exposure data, or validated modeling results, HED remains concerned that the existing buffer zones may not be not adequately protective and would not prevent ethyl parathion exposure to bystanders. The registrant is a member of the Spray Drift Task Force and HED reserves the decision concerning the magnitude of bystander spray drift exposure and the required buffer zone until data from the task force are fully evaluated.

V. Incident Data

Based on a recent review of ethyl parathion poisoning data (1992-1996) following the consent agreement, the following poisoning incidents have been reported (memo from Jerome Blondell (HED) to Jonathan Becker (HED), dated March 30, 1998):

- Incident Data System (IDS) includes two incidents, one from Minnesota and one from South Dakota. Both were related to spray drift exposure. Systemic / health effects were not reported.

- California reported six incidents involving ethyl parathion in 1992 and no incidents from 1993 through 1996. Three incidents involved drift from a plum orchard related to misuse. The three other incidents related to handlers cleaning or working on spray rigs.

- Poison Control Center data from 1993 through1996 report 72 cases of ethyl parathion exposures. Thirty-four cases were followed to determine outcome, with 13 cases with minor medical outcome and 4 cases with moderate outcome. It appears that most of these cases involve spray drift, given that they occur in a residence and generally involve environmental residues.

VI. Conclusions

Based on the above occupational exposure and risk assessment, HED concludes:

- The use of risk mitigation measures for occupational handlers (i.e., maximum PPE and engineering controls) will not result in MOEs greater than 100 at the application rates supported by the registrant.

- Occupational postapplication assessment indicate that REIs range from 64 to 84 days for standard values and from 42 to 62 days for reentry using maximum PPE. These intervals are substantially greater than the current label restricted-entry period of 3 days.

- In the absence of exposure data, or validated modeling results, HED cannot verify that the buffer zone of 100 feet is adequately protective to bystanders. Because the registrant is a member of the Spray Drift Task Force, HED reserves the decision concerning the magnitude of bystander spray drift exposure and the required buffer zone until data from the task force are evaluated. Poison Control Center data indicate that residential exposure to ethyl parathion spray drift occurs.

VII. Summary

Ethyl parathion, formulated only as an emulsifiable concentrate, is a restricted use pesticide used as an insecticide on 9 crops. The Agency and the registrant entered into a consent agreement in 1991 that placed numerous restrictions on the mixing, loading, and application of ethyl parathion. Further, constraints were placed on the restricted entry interval, such as limiting the time spent by workers in a treated area to 1 hour per 24 hour period and requiring additional PPE.

Based on HED's occupational exposure and risk assessment, the MOEs for ethyl parathion are much less than 100 for all handler scenarios (less than 1 for all scenarios even with maximum PPE or engineering controls). Restricted entry intervals are calculated to be greater than 40 days for scouts wearing PPE and spending 1 hour per day in the treated area. These estimates are based on standard values expected to be found in typical agricultural settings where ethyl parathion is being used.

cc: Richard Griffin (OPP/HED/RRB2)
OREB Files

Table 5: Occupational Handler Short- and Intermediate-term Dermal and Inhalation Exposures to Ethyl Parathion with Baseline Clothing.

Exposure Scenario (Scenario #)	Baseline Dermal Unit Exposure (mg/lb ai)[a]	Baseline Inhalation Unit Exposure (µg/lb ai)[b]	Crop	Range of Application Rates (lb ai/acre)[c]	Daily Acres Treated[d]	Daily Dermal Exposure (mg/day)[e]	Daily Inhalation Exposure (mg/day)[f]
Mixer/Loader Exposure							
Mixing/loading liquids for aerial application (1)	2.9	1.2	Alfalfa, Canola	0.5	350	510	0.21
			Barley, Corn, Soybeans, Wheat	0.75		760	0.32
			Cotton, Sorghum, Sunflower	1		1000	0.42
Applicator Exposure							
Applying sprays with fixed wing aircraft (2)	See engineering controls.	See engineering controls.	Alfalfa, Canola	0.5	350	See engineering controls.	See engineering controls.
			Barley, Corn, Soybeans, Wheat	0.75		See engineering controls.	See engineering controls.
			Cotton, Sorghum, Sunflower	1		See engineering controls.	See engineering controls.
Applying sprays with helicopter (3)	—	—	—	—		—	---
Flagger Exposure							
Human flaggers are explicitly prohibited.	---	---	---	---	---	---	---

[a] Baseline dermal unit exposure represents long pants, long sleeved shirt, no gloves, open mixing/loading, open cab tractor.

[b] Baseline inhalation exposure represents no respirator.

[c] Application rates are the maximum single application rates provided by Cheminova in support of ethyl parathion tolerances for the 9 registered crops.

[d] Daily acres treated values are based on EPA HED estimates of acreage that could be treated in a single day for each exposure scenario of concern.

[e] Daily dermal exposure (mg/day) = Unit exposure (mg/lb ai) * Appl. rate (lb ai/acre) * Acres treated.

[f] Daily inhalation exposure (mg/day)= Unit exposure (µg/lb ai) * (1mg/1000 µg) Unit conversion * Application rate (lb ai/A) * Acres treated.

Table 6: Occupational Handler Short-term and Intermediate-term Risks from Ethyl Parathion with Baseline Clothing.

Exposure Scenario (Scenario #)	Crop	Baseline Dermal			Baseline Inhalation			Baseline Total		
		Daily Dose (mg/kg/day) [a]	Short-term MOE[b]	Intermediate-term MOE[c]	Daily Dose (mg/kg/day)[d]	Short-term MOE[e]	Intermediate-term MOE[f]	Daily Dose (mg/kg/day)[g]	Short-term MOE[h]	Intermediate-term MOE[i]
Mixer/Loader Exposure										
Mixing/loading liquids for aerial application (1)	Alfalfa, Canola	7.3	0.0014	0.00028	0.003	3.3	0.67	7.3	0.0014	0.00028
	Barley, Corn, Soybeans, Wheat	11	0.00092	0.00018	0.0045	2.2	0.44	11	0.00092	0.00018
	Cotton, Sorghum, Sunflower	15	0.00069	0.00014	0.006	1.7	0.33	15	0.00069	0.00014
Applicator Exposure										
Applying sprays with fixed wing aircraft (2)	Alfalfa, Canola	See engineering controls.	See engineering controls.	See engineering controls.	See engineering controls.	See engineering controls.	See engineering controls.	See engineering controls.	See engineering controls.	See engineering controls.
	Barley, Corn, Soybeans, Wheat	See engineering controls.	See engineering controls.	See engineering controls.	See engineering controls.	See engineering controls.	See engineering controls.	See engineering controls.	See engineering controls.	See engineering controls.
	Cotton, Sorghum, Sunflower	See engineering controls.	See engineering controls.	See engineering controls.	See engineering controls.	See engineering controls.	See engineering controls.	See engineering controls.	See engineering controls.	See engineering controls.
Applying sprays with helicopter (3)	—	—	—	—	—	—	—	—	—	---
Flagger Exposure										
Human flaggers are prohibited.	---	---	---	---	---	---	---	---	---	---

[a] Baseline dermal daily dose (mg/kg/day) = Daily dermal exposure (mg/kg) / Body weight (70 kg).
[b] Baseline dermal short-term MOE = Short-term NOAEL (0.01 mg/kg/day) / Baseline dermal daily dose (mg/kg/day).
[c] Baseline dermal intermediate-term MOE = Intermediate-term NOAEL (0.002 mg/kg/day) / Baseline dermal daily dose (mg/kg/day).
[d] Baseline inhalation daily dose (mg/kg/day) =Daily inhalation exposure (mg/kg) / Body weight (70 kg).
[e] Baseline inhalation short-term MOE = Short-term NOAEL (0.01 mg/kg/day) / Baseline inhalation daily dose (mg/kg/day).
[f] Baseline inhalation intermediate-term MOE = Intermediate-term NOAEL (0.002 mg/kg/day) / Baseline inhalation daily dose (mg/kg/day).
[g] Baseline total daily dose (mg/kg/day) = Baseline dermal daily dose (mg/kg/day) + Baseline inhalation daily dose (mg/kg/day).
[h] Baseline total short-term MOE = Short-term NOAEL (0.01 mg/kg/day) / Baseline total daily dose (mg/kg/day).
[I] Baseline total intermediate-term MOE = Intermediate-term NOAEL (0.002 mg/kg/day) / Baseline total daily dose (mg/kg/day).

Table 7: Occupational Handler Short-term and Intermediate-term Risks from Ethyl Parathion with Maximum PPE

Exposure Scenario (Scenario #)	Crop	Dermal - Maximum PPE				Inhalation - Maximum PPE				Total - Maximum PPE		
		Unit Exposure (mg/lb ai) [a]	Daily Dose (mg/kg/day) [b]	Short-term MOE[c]	Int.-term MOE[d]	Unit Exposure (mg/lb ai) [e]	Daily Dose (mg/kg/day) [f]	Short-term MOE[g]	Int.-term MOE[h]	Daily Dose (mg/kg/day)[i]	Short-term MOE[j]	Int.-term MOE[k]
Mixer/Loader Exposure												
Mixing/loading liquids for aerial application (1)	Alfalfa, Canola	0.017	0.043	0.24	0.047	1.2E-04	0.0003	33	7	0.043	0.23	0.047
	Barley, Corn, Soybeans, Wheat		0.064	0.16	0.031		0.00045	22	4	0.064	0.16	0.031
	Cotton, Sorghum, Sunflower		0.085	0.12	0.024		0.0006	17	3	0.086	0.12	0.023
Applicator Exposure												
Applying sprays with a fixed-wing aircraft (2)	Alfalfa, Canola	See eng. controls.	See eng. controls	See eng. controls.	See eng. controls.	See eng. controls.	See eng. controls.	See eng. controls.	See eng. controls.	See eng. controls.	See eng. controls.	See eng. controls.
	Barley, Corn, Soybeans, Wheat		See eng. controls.	See eng. controls.	See eng. controls.		See eng. controls.	See eng. controls.	See eng. controls.	See eng. controls.	See eng. controls.	See eng. controls.
	Cotton, Sorghum, Sunflower		See eng. controls.	See eng. controls.	See eng. controls.		See eng. controls.	See eng. controls.	See eng. controls.	See eng. controls.	See eng. controls.	See eng. controls.
Applying sprays with a helicopter (3)	—	—	—	—	—	—	—	—	—	—	—	---
Flagger Exposure												
Human flaggers are prohibited.	---	---	---	---	---	---	---	---	---	---	---	---

[a] Maximum PPE dermal unit exposure (mg/day) represent coveralls over long pants, long sleeved shirt, chemical-resistant gloves.
[b] Maximum PPE dermal daily dose (mg/kg/day) = [Maximum PPE dermal unit exposure (mg/lb ai) * Appl. rate (lb ai/acre) * Acres treated] / Body weight (70 kg).
[c] Maximum PPE dermal short-term MOE = Short-term NOAEL (0.01 mg/kg/day) / Maximum PPE dermal daily dose (mg/kg/day).
[d] Maximum PPE dermal intermediate-term MOE = Intermediate-term NOAEL (0.002 mg/kg/day) / Maximum PPE dermal daily dose (mg/kg/day).
[e] Maximum PPE inhalation unit exposure (ug/lb ai) represent organic vapor respirator.
[f] Maximum PPE inhalation daily dose (mg/kg/day) = [Maximum PPE inhalation unit exposure (mg/lb ai) * Appl. rate (lb ai/acre) * Acres treated] / Body weight (70 kg).
[g] Maximum PPE inhalation short-term MOE = Short-term NOAEL (0.01 mg/kg/day) / Maximum PPE inhalation daily dose (mg/kg/day).
[h] Maximum PPE inhalation intermediate-term MOE = Intermediate-term NOAEL (0.002 mg/kg/day) / Maximum PPE inhalation daily dose (mg/kg/day).
[I] Maximum PPE total daily dose (mg/kg/day) = Maximum PPE dermal daily dose (mg/kg/day) + Maximum PPE inhalation daily dose (mg/kg/day).
[j] Maximum PPE total short-term MOE = Short-term NOAEL (0.01 mg/kg/day) / Maximum PPE total daily dose (mg/kg/day).
[k] Maximum PPE total intermediate-term MOE = Intermediate-term NOAEL (0.002 mg/kg/day) / Maximum PPE total daily dose (mg/kg/day).

Table 8: Occupational Handler Short-term and Intermediate-term Risks from Ethyl Parathion with Engineering Controls

Exposure Scenario (Scenario #)	Crop	Dermal - Engineering Controls				Inhalation - Engineering Controls				Total - Eng. Controls		
		Unit Exposure (mg/lb ai)[a]	Daily Dose (mg/kg/day)[b]	Short-term MOE[c]	Int.-term MOE[d]	Unit Exposure (mg/lb ai)[e]	Daily Dose (mg/kg/day)[f]	Short-term MOE[g]	Int.-term MOE[h]	Daily Dose (mg/kg/day)[i]	Short-term MOE[j]	Int.-term MOE[k]
Mixer/Loader Exposure												
Mixing/loading liquids for aerial application (1)	Alfalfa, Canola	0.0086	0.022	0.47	0.093	8.3E-05	0.00021	48	10	0.022	0.46	0.092
	Barley, Corn, Soybeans, Wheat		0.032	0.31	0.062		0.00031	32	6	0.033	0.31	0.061
	Cotton, Sorghum, Sunflower		0.043	0.23	0.047		0.00042	24	5	0.043	0.23	0.046
Applicator Exposure												
Applying sprays with a fixed-wing aircraft (2)	Alfalfa, Canola	0.005	0.013	0.8	0.16	6.8E--05	0.00017	59	12	0.013	0.79	0.16
	Barley, Corn, Soybeans, Wheat		0.019	0.53	0.11		0.00026	39	8	0.019	0.53	0.11
	Cotton, Sorghum, Sunflower		0.025	0.40	0.080		0.00034	29	6	0.025	0.39	0.079
Applying sprays with helicopter (3)	—	—	—	—	—	—	—	—	—	—	—	---
Flagger Exposure												
Human flaggers are prohibited.	---	---	---	---	---	---	---	---	---		---	---

[a] Engineering Controls dermal unit exposure (mg/day) represent long pants, long sleeved shirt, no gloves in an enclosed cab or cockpit

[b] Engineering Controls dermal daily dose (mg/kg/day) = [Engineering Controls dermal unit exposure (mg/lb ai) * Appl. rate (lb ai/acre) * Acres treated] / Body weight (70 kg).

[c] Engineering Controls dermal short-term MOE = Short-term NOAEL (0.01 mg/kg/day) / Engineering Controls dermal daily dose (mg/kg/day).

[d] Engineering Controls dermal intermediate-term MOE = Intermediate-term NOAEL (0.002 mg/kg/day) / Engineering Controls dermal daily dose (mg/kg/day).

[e] Engineering Controls inhalation unit exposure (ug/lb ai) represent enclosed cab or cockpit.

[f] Engineering Controls inhalation daily dose (mg/kg/day) = [Engineering Controls inhalation unit exposure (mg/lb ai) * Appl. rate (lb ai/acre) * Acres treated] / Body weight (70 kg).

[g] Engineering Controls inhalation short-term MOE = Short-term NOAEL (0.01 mg/kg/day) / Engineering Controls inhalation daily dose (mg/kg/day).

[h] Engineering Controls inhalation intermediate-term MOE = Intermediate-term NOAEL (0.002 mg/kg/day) / Engineering Controls inhalation daily dose (mg/kg/day).

[I] Engineering Controls total daily dose (mg/kg/day) = Engineering Controls dermal daily dose (mg/kg/day) + Engineering Controls inhalation daily dose (mg/kg/day).

[j] Engineering Controls total short-term MOE = Short-term NOAEL (0.01 mg/kg/day) / Engineering Controls total daily dose (mg/kg/day).

[k] Engineering Controls total intermediate-term MOE = Intermediate-term NOAEL (0.002 mg/kg/day) / Engineering Controls total daily dose (mg/kg/day).

Table 9: Occupational Exposure Scenario Descriptions for the Use of Ethyl Parathion

Exposure Scenario (Number)	Data Source	Standard Values[a] (8-hr work day)	Comments[b]
Mixer/Loader Exposure			
Mixing/Loading Liquid Formulations (1)	PHED V1.1	350 acres	**Baseline:** "Best Available" grades: Hands, dermal, and inhalation based on acceptable grades. Dermal = 72 to 122 replicates; hands = 53 replicates; and inhalation= 85 replicates. High confidence in all data. **PPE:** "Best Available" grades: Hands, dermal, and inhalation = acceptable grades. Dermal = 72 to 122 replicates; hands = 59 replicates; and inhalation = 85 replicates. High confidence in all data. **Engineering Controls:** "Best Available" grades: Hands, dermal, and inhalation = acceptable grades; Dermal = 16 to 22 replicates; hands = 31 replicates; and inhalation = 27 replicates. High confidence in all data. PHED data were used for baseline, no protection factors (PFs) were necessary. A 50% PF was added to simulate coveralls for PPE. An 90% PF was used for PPE for inhalation to represent an organic vapor respirator. Engineering Controls data were monitored with chemical resistant gloves.
Applicator Exposure			
Applying Sprays with a Fixed-wing Aircraft (2)	PHED V1.1	350 acres	**Baseline:** Enclosed cockpit considered to be an engineering control. **Engineering controls:** "Best Available" grades: Dermal and inhalation = ABC grades; and hands = acceptable grades. Dermal = 24 to 48 replicates; hands = 34 replicates; and inhalation = 23 replicates. Medium confidence in all data. PHED data were used for baseline, no PFs were necessary.
Applying Sprays with a Helicopter (3)	---	---	---
Flagger Exposure			
Human Flaggers are explicitly prohibited on all labels.	---	---	___

[a] Standard Values based on an 8-hour work day as estimated by EPA. Chemical-specific use data were not available from the Biological and Economic Analysis Division.

[b] "Best Available" grades are defined by EPA SOP for meeting Subdivision U Guidelines. Acceptable grades are matrices with grades A and B data. Data confidence are assigned as follows:

High = grades A and B and 15 or more replicates
Medium = grades A, B, and C and 15 or more replicates
Low = grades A, B, C, D, and E or any combination of grades with less than 15 replicates.